Diatek® Model 600 Thermometer

Technical Manual

Welch Allyn®
Diatek Instruments

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WARRANTY

1-YEAR LIMITED WARRANTY ON NEW INSTRUMENTS: Instrumentation purchased new from Diatek Instruments, Inc. (Diatek) is warranted to be free from original defects in material and workmanship under normal use and service for a period of one year from the date of first shipment from Diatek. This warranty shall be fulfilled by Diatek or its authorized representative repairing or replacing at Diatek's discretion, any such defect, free of charge for parts and labor.

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MODEL 600 OPERATIONAL CHARACTERISTICS

The Diatek Model 600 Digital Thermometer is a portable instrument for measuring patient temperatures over the 84°F to 108°F (28.9°C to 42.2°C) range. The Model 600 features an LCD readout with backlight, interchangeable probes, disposable prove covers, disposable batteries with a capacity for up to 45,000 temperatures, automatic power shutdown, both normal and monitor modes of operation and self-calibration/test capability.

Normal Mode

Removal of the probe automatically turns on the Model 600 and places it in the predict mode when selected by the normal/monitor slide switch. All segments of the display except the pulse timer are lighted simultaneously for 6 seconds as a display test and the horn is tested for 0.1 seconds. The display will read 84.0 (28.9) with the down arrow on until the probe exceeds that temperature and will ten display a rising temperature for about 30 seconds.

When the readout has stabilized, the horn will sound for 1 second, the “F” or “C” symbol will light and the display will remain fixed indicating the end of the temperature taking cycle. The displayed temperature will be the actual probe temperature plus a computed correction factor. The probe temperature is sensed about 4 seconds from turn on to correct for ambient probe temperature variations. If the temperature measurement cycle is not completed within 5 minutes from turn on, the thermometer will turn off at that time. A temperature in excess of 108°F (42.2°C) will cause an error condition to be indicated by the horn beeping twice every 10 seconds and the up arrow blinking. Five minutes of this error condition causes the thermometer to turn off. Returning the probe to its holder and then removing it will restart the thermometer.

Note: The normal mode display is peak reading and will not read down.

Monitor Mode

Removal of the probe automatically turns on the Model 600 and places it in the monitor mode when selected by the normal/monitor slide switch. All segments of the display except the pulse timer are lighted simultaneously for 6 seconds as a display test and the horn is tested for 0.1 seconds. The display will then indicate the actual probe temperature, updating every 1.5 seconds as long as it remains within the 84°F to 108°F (28.9°C to 42.2°C) range, and will show the appropriate up or down arrow when outside this range. Five minutes of operation outside the operating range will cause the thermometer to turn off.

Pulse Timer

Pressing the pulse timer switch at any time causes the 30 second clock type display to start. One additional segment is turned on each second until 30 seconds has been reached at which time the timer display goes blank. The horn sounds for 0.1 second at 0,15, and 30 seconds. Pressing the timer switch while the timer is running causes the timer to restart. The switch will not respond if pressed sooner than 1.5 seconds since the last timer activation.

Backlight

The backlight is activated as long as the backlight switch is pressed and the thermometer function is active. In the predict mode, activating the backlight any time prior to the end of the temperature taking cycle will cause the backlight to turn on for 5 seconds when the final temperature has been reached and the horn sounds. No backlight is available when only the pulse timer is in use.

Error Indicators

Probe Position Error—During normal mode operation the visual probe position error indicator will be displayed as long as tissue contact is broken and the probe temperature is falling. This display indicates that a condition exists which may not provide accurate temperatures. The error indicator does not affect the temperature taking cycle in any way.

No temperatures may be taken when any of the following error conditions exist:

Broken Probe

A probe error will be indicated if the probe circuit is open (below 10° greater than 60,000 ohms) or shorted (above 150° F or less than 2,000 ohms). The horn sounds a double beep repeating every 10 seconds with the probe error display flashing. The unit will shut off automatically after 5 minutes of error indication. The error will be detected any time during predict or monitor mode operation.

Low Battery

A low battery condition exists when the battery voltage drops to approximately 3.0 volts. A low battery indication may occur any time during monitor mode operations but only at the start of a predict mode temperature. If a low battery condition exists prior to starting the pulse timer, the low battery error will be displayed when the timer is started and any normal mode temperature in progress will abort at that time. The low battery error displays a flashing symbol with a double horn beep sounding every 10 seconds. The unit will shut off automatically after five minutes of error indication.

Instrument Malfunction

A malfunction error will be indicated if either the internal calibration self-test or the internal microprocessor self-test fails. The malfunction indicator flashes with a double horn beep sounding every 10 seconds. The thermometer will automatically shut off after five minutes of error indication.

Self-Tests

Battery Installation Display Test

Immediately following the installation of batteries into the Model 600, a one time only display test is provided. All segments of the entire display (including the pulse timer and error indicators) are sequentially lighted for 0.4 seconds. The entire test takes 25 seconds and must occur prior to starting any temperature or timer functions.

Thermometer Startup Tests

Display and Horn Test

Each time the probe is removed from its holder all display segments (except for the pulse timer) are lighted for 6 seconds as a visual display test. During the display test the horn sounds for 0.1 second.

Internal Calibration Test

During each thermometer startup display test a precision resistor is used to check the thermometer calibration at 100.5°F (38.1°C). A failure of the thermometer to measure the calibration resistor within ±0.2°F will cause the malfunction error to flash, the horn will sound with a double beep every 10

seconds and no temperature measurement will be allowed. The thermometer will automatically shut off after 5 minutes of the error display.

Internal Microprocessor Test

During each thermometer display test a check sum of all program memory is calculated and compared against a reference stored in the program memory. An error in the check sum will cause the malfunction error to flash, the horn will sound with a double beep every 10 seconds, and no temperature measurement will be allowed. The thermometer will shut off after 5 minutes of the error display.

Battery Life

Shelf Life

The shelf life of *carbon zinc chloride* or *alkaline* batteries should be at least three years when stored at 70°F. The storage life degrades rapidly with increased temperature.

Temperature Taking Without Backlight

The Model 600 should operate continuously for about 2,000 hours when the backlight is not used. If an operating time of 2 minutes per temperature is assumed then the potential number of temperatures that can be taken should be about 2,000 hours @ 30 temperatures/hour = 60,000 temperatures.

Temperature Taking With Backlight

The backlight uses about 20 times more power than the rest of the thermometer. If 20 seconds of backlight usage is assumed for each temperature taken then the number of temperatures that can be taken should be about 17,300 temperatures.

C/F Mode Switch

The display mode may be changed between Fahrenheit and Celsius at any time prior to, during, or after taking a temperature by activating the C/F slide switch. The numbers will change as the switch is activated, however, the C/F indicator is only visible at the end of a normal mode temperature.

Normal/Monitor Mode Switch

The selection of normal or monitor mode operation should be made prior to turning on the thermometer by setting the normal monitor switch to the desired position. Once the thermometer has been turned on, a change from normal to monitor mode may be made at any time, however, a change from monitor to normal will cause the horn to beep twice and the thermometer to shut off. This error indication and shut off prevents a normal mode temperature from being started with the probe already in place.

MODEL 600 THEORY OF OPERATION

Note: Refer to Model 600 Thermometer Block Diagram and Model 600 Schematic Diagram.

Technical Overview

The heart of the Model 600 is comprised of two custom integrated circuits which provide the microprocessor and analog circuit functions. All control and display functions are governed by the microprocessor (U2) and all analog interfacing to the microprocessor, probe, horn and backlight is provided by U1. Probe resistance measurements are made by ratioing pulse widths generated by sequentially switching in two calibration resistors and the probe thermistor. These pulse widths are measured by the microprocessor which calculates the probe resistance. The actual probe temperature is then calculated from the probe resistance.

During monitor mode operation, the actual probe temperature appears directly on the liquid crystal display which is driven by the integral LCD driver on the microprocessor.

During normal mode operation, the shape of the rising temperature curve is monitored and a continuously computed correction factor is added to the actual probe temperature. The normal mode temperature cycle is terminated when the predicted temperature remains stable.

All switch inputs are monitored by the microprocessor which in turn activates the required functions.

Inputs to the microprocessor are A/D output pulse widths, switches, low battery detection, power on reset, microprocessor clock and interval timer clock.

Outputs from the microprocessor control the display, analog IC and display power, backlight, horn and calibration resistor selection.

To extend battery life, the power to both the analog lC (U1) and the LCD reference are turned off and the microprocessor is put to sleep when possible.

Power to the thermometer is always connected and is not turned on and off by the probe or pulse switch functions.

Temperature Measurement and Display

When batteries are installed in the thermometer, C4 and RN1-B provide a power on reset pulse to the microprocessor (U2-56). C3 and RN1-A set the microprocessor clock frequency at approximately 200 kHz. Following the high going reset pulse, the microprocessor initiates the power on display test which causes display segments (DS1) to be sequentially lighted for 0.4 seconds and then extinguished. After the completion of the display test which lasts approximately 25 seconds, the microprocessor then goes into a sleep mode awaking 8 times per second to test the probe switch S1. If the probe is in the thermometer (S1 open) or the probe is disconnected, then the microprocessor returns to sleep for another 1/8 of a second. The pulse timer switch (S5) is connected to an interrupt input on the microprocessor (U2-63) and will wake up the microprocessor and start the 30 second pulse timer.

In the sleep mode and even when only the pulse timer is active, the 200 kHz clock (U2-59) will be seen to turn on for about 2 milliseconds every 1/8 of a second. If when tested, the probe switch circuit is found to be active, the microprocessor turns on display power by setting U2-10 low and initiates a 6 second display test which turns on all display segments except the 30 second pulse timer simultaneously. During the display test the following events take place.

1. The A/D power control line (U2-3) is set high by the microprocessor to turn on the power to U1.

2. The low battery detector output (Ul-9) is tested by the microprocessor. A low logic level on Ul-9 indicates a low battery condition (less than 3.0 volts).
3. The horn drive signal (U2-11) goes high activating the horn test for 0.1 second.
4. The backlight switch, normal/monitor switch and F/C switches are tested by the microprocessor.
5. A calibration cycle is performed.
6. The calibration test is performed.
7. The microprocessor memory test is performed.
8. The probe resistance is tested for an open or shorted condition.

Following the events which take place during the display test, a continuous monitor mode temperature measurement or a predict mode temperature taking cycle is started.

Probe Temperature Measurement

Q3-Q6, Q8, R3-R5, R-16, C2 and U1 comprise a unique resistance to pulse width conversion circuit which allows any one of 4 resistance's to be measured by the microprocessor. The circuit allows the microprocessor to select precision resistors with equivalent temperatures at opposite ends of the temperature measurement range and measure their relative pulse widths.

The microprocessor sets U2- 16 to 19 high as required to select the appropriate resistance to be measured. R3 provides a pulse width calibration at 93.2 °F, R5 provides calibration at 106.9 °F and R3 is used for a calibration test at 100.5 °F. A ratiometeric calculation is used to compute the probe resistance from its pulse width relative to those provided by R3 and R5. The accuracy of each calibration resistor is .05 °F. A resistance to pulse width conversion is initiated by the microprocessor setting U2-64 high for approximately 0.5 seconds with the appropriate FET switch selected sometime within that period. U2-64 is then set low and the time from this transition until the A/D output (U1-2) goes high is measured by the microprocessor. The crystal X1 provides the time base for the pulse width measurements. The probe temperature is computed using the probe resistance value obtained from the ratiometeric pulse width calculations.

Monitor Mode Operation

In the monitor mode a new probe temperature measurement is completed every 1.5 seconds and a new calibration cycle is completed every 3 seconds. The computed probe temperature is displayed directly on the liquid crystal display and will follow both upward and downward movement.

Normal Mode Operation

In the normal mode. a new probe temperature measurement is completed every 1.5 seconds. At least one calibration cycle is performed at the start of a predict cycle and continue every 3 seconds until the probe temperature rises above 84.0 °F. The calibration cycle is stopped at this point to reduce quantizing errors associated with the measurement of the slowly changing probe temperature.

The normal mode displayed temperature is the sum of the actual probe temperature and a computed correction factor which is based on the shape of the changing temperature curve at that point in time. The values of the correction factor can vary from 0 °F to 2.3 °F with a typical value when the horn sounds of about 1 °F. During the display test prior to starting a normal mode temperature cycle, the ambient temperature of the probe is measured and is used in the correction factor computation to adjust for differing probe starting conditions. The normal mode display is peak reading and therefore the highest temperature is displayed even though the present predicted probe temperature may drop.

The normal mode temperature cycle is terminated when the predicted temperature remains stable for several seconds.

SELF TESTS

Internal Calibration Test

The calibration test is performed only once during a temperature taking cycle and occurs during the display test. Upon completion of the first calibration cycle, the resistance of R4 is measured and compared against limits stored in the microprocessor memory. The specified limits are 5740 and 5780 ohms. If the resistance calculated by the microprocessor when the pulse width of R4 is measured does not fall within these limits, the malfunction error is displayed.

Internal Microprocessor Memory Test

The microprocessor memory test is performed only once during a temperature taking cycle and occurs during the display test. Each 8 bit byte of program memory is divided into two 4 bit nibbles which are summed. The total sum of all nibbles and a special check sum compensation nibble must be O or the malfunction error is displayed.

Broken Probe Test

Each probe resistance sample that is taken is checked to see that it lies between 2000 and 60,000 ohms. A resistance value outside of these limits will cause a broken probe error to be displayed.

DISPLAY

Display Voltage Reference

Diodes CR2-CR6. Q7, R61 and R7 create the display voltage references of about (V+)—1 volt at U2-25 (V+)—2 volts at U2-24 and (V+)—3 volts at U2-23.

Display

The liquid crystal display is of the 4 backplane multiplexed type (quadraplex), requires a regulated operating voltage, and is driven directly by the microprocessor.

Horn

The microprocessor provides a control signal to U1-3 which is the feedback input for the horn driver contained in U1. The horn driver output (U1-l) drives the horn (H1) at its self resonant frequency of about 6 kHz.

Backlight

The microprocessor activates the backlight by setting U2-4 high. This signal is inverted and buffered and reappears at U1-13 going low. A low level on U1-13 turns on the backlight inverter circuit consisting of Q1, Q2, R1, R2, C5 and T1. The inverter supplies an AC voltage of about 80 volts and 300 Hz to the Electroluminescent panel BP1. CR7 blocks negative voltage spikes from entering U1-13.

Power Consumption

Without the thermometer or pulse timer active the average battery current should be under 50 microamperes. When the thermometer function is active the average battery current should be about 1 milliamp.

Maximum battery current with the backlight on should be about 25 milliamperes.

Low Battery Detection

When the battery voltage is reduced to 3.2 volts, Ul-9 goes low indicating a low battery condition to the microprocessor which in turn causes the low battery indication to be displayed.

Pulse Timer Operation

Pressing the pulse timer switch activates the microprocessor interrupt to (U2-63) starting the pulse timer display. The pulse timer input is independent from the temperature taking functions and may be activated at any time. Starting the pulse timer causes the microprocessor to turn on the horn for 0.1 seconds at 0, 15 and 30 seconds and light one additional clock segment each second until the display is fully lighted at 30 seconds at which time the clock display blanks. The timer cannot be restarted for 1.5 seconds following the last press of the timer switch but may be restarted at any later time.

Figure 1 - Block Diagram

Figure 2 - Schematic

Figure 3 - Schematic (earlier serial numbers)

Figure 4 - Printed Circuit Board Component Layout

Figure 5 - Final Assembly

Figure 6 - Operating Controls and Components

SPECIFICATIONS

Range:	Normal and monitor modes
	28.9°C to 42.2°C
	84.0 °F to 108.0 °F
Accuracy:	±0.1 °C, ±0.2 °F (when tested in a calibrated water bath)
Battery Capacity:	disposable batteries
	three type AA cells
	up to 1000 hours of continuous use
Dimensions:	length 6.25 inches (159mm); width 3.7 inches (94mm); height 2.4 inches (61mm)
	weight: 10.5 ounces (298 grams)
	case material: ABS Cycolac “T” grade plastic
Visual and Audible Indicators:	digital temperature display
	30 second pulse and respiration timer
	instrument malfunction
	broken probe
	probe position
	low battery
	out of range temperature

OPERATING INSTRUCTIONS

Set-up Procedure

1. Unpack the Model 600 Thermometer and probes, checking for any damage that may have occurred during shipping.
2. Insert the plug of the probe to be used into the thermometer receptacle and then insert the probe shaft into the probe storage channel of the thermometer. The thermometer will not turn on with the probe disconnected.
3. Insert a box of 25 probe covers into the storage well of the thermometer.
4. Attach the 250 probe cover dispenser to the wall in a convenient location.

Preparation for temperature measurement:

1. Place the carrying strap around your neck with the instrument display facing you.
2. Check that sufficient probe covers remain for a round of temperature taking.
3. Select the desired Fahrenheit or Celsius display by setting the °F/ °C slide switch to the appropriate position.
4. Select the mode of temperature measurement.

Normal Mode Operation

The normal mode of operation provides a rapid means of oral or rectal temperature taking under most conditions.

Set the normal/monitor slide switch to the normal position. Withdraw the probe from the storage channel and observe the 6 second display test ensuring that no display segments are missing. The unit will then display 84.0 °F (28.9 °C) with the low temperature arrow ON until the probe rises above that temperature.

Oral Temperature Measurement

Load a probe cover onto the probe by holding the probe collar with the thumb and forefinger being careful not to hold or press the ejection button.

Insert the probe tip gently into patient’s slightly open mouth. Carefully slide probe under the tongue on either side of the mouth to reach the sublingual artery.

Have the patient close lips around the probe.

Hold the probe during the entire temperature measurement process and keep the probe tip in contact with tissue at all times.

During the temperature taking cycle, a continually increasing temperature should be observed on the display. When the final temperature has been reached, a tone will sound and an “F” or “C” will be displayed to the right of the numbers.

After temperature measurement is complete, eject the probe cover by firmly pressing the ejection button on the probe. Insert into the probe channel to clear the display in preparation for another temperature.

Rectal Temperature Measurement

Exchange the blue oral probe for the red rectal probe by removing the connector plug from the thermometer and the probe from the storage channel. Complete the exchange by placing the rectal probe in the storage channel and plugging the connector into the thermometer.

Load a probe cover and observe the thermometer start up display as in the oral procedure.

Separate the buttocks with one hand. Apply lubricant if necessary. Using the other hand, gently insert the probe only 1 cm (3/8 inch). The insertion depth should be less in infants and small children.

Tilt the probe so the tip is touching tissue and continue to keep the buttocks separated.

Monitor Mode Operation

Monitor mode operation is normally used for longer term monitoring or when difficult situations prevent accurate temperatures from being taken in the predict mode. The probe must be in place against tissue for at least 3 minutes for accurate temperature measurement. Because of ambient temperature influence and other factors, monitoring temperatures may not be identical to predict temperatures. The fluctuation in temperature is the important standard to be observed during monitoring.

To take a temperature in the monitor mode, set the normal/monitor switch to the monitor position. Insert the continuous monitor probe connector. Connect the desired sensor type to the thermometer causing the 6 second display test to appear. Verify that no display symbols are missing and then attach the probe to the patient as required. Once the temperature readout has been allowed 3 minutes to stabilize, the patient may be continuously monitored as long as is necessary.

The symbol “M” on the display indicates that the unit is operating in monitor mode. The Model 600 will turn off after 5 minutes if a temperature above 84.0 °F (28.9 °C) is not sensed.

Backlight Operation

The display backlight is used to allow the display to be read in poorly lighted areas. This function should not be used unnecessarily as it will shorten the thermometer battery life.

Pressing the backlight switch any time the thermometer function is active will cause the backlight to turn on as long as the button is being pressed. In the predict mode, activating the backlight prior to the horn sounding causes the backlight to activate for 5 seconds after the horn sounds.

Pulse Timer

The pulse timer may be used to determine a patient’s pulse or respiration rate.

Press the pulse timer switch once the pulse or breath has been located. The timer will beep at 0, 15, and 30 seconds. The number of pulses or breaths noted in 15 seconds should be multiplied by 4 to obtain the pulse or respiration rate per minute.

The number of pulses or breaths noted in 30 seconds should be multiplied by 2 for the pulse or respiration rate per minute.

The timer may be restarted at any time by pressing the pulse timer switch.

°F/°C Conversion

The °F/°C switch may be changed at any time to allow reading in Fahrenheit or Celsius scales.

Error Indicators

When any of the following errors occur, a tone will sound twice for .1 seconds and the appropriate error indicator will be flashing on and off (.5 seconds). Except for probe position error, no temperature will be displayed while in the error mode and the unit will shut off in 5 minutes.

Horn will repeat the double beep every 10 seconds if error is not rectified.

Broken Probe

This error is intended to indicate that the probe will not function correctly and should be replaced.

Low Batteries

The purpose of the low battery indication is to preclude an improper reading, and to notify the user to change batteries.

The following conditions will display a low battery error and prevent a temperature or timer display.

1. A low battery condition any time during monitor mode, regardless of pulse time.
2. A low battery condition existing prior to starting a predict mode temperature or activating the pulse timer.

Note: Activating the pulse timer when a low battery condition exists will cause a predict temperature in progress to be terminated.

Probe Position Error

The “probe position error” is an indicator that appears whenever there is a rapid drop in temperature. This can be the result of excessive probe movement or poor tissue contact. No audible tone will sound for this error indication, however, a visual indicator will activate.

Temperature display is unaffected by this indicator, except that it will not update until temperature rises.

Malfunction

The “Malfunction” error indicator activates after the self check whenever the thermometer will not function correctly (does not include probe and battery malfunctions).

Self Tests

Initial Power Up Display

A special display test is performed each time a new set of batteries is installed. Upon inserting batteries, all display segments are sequentially turned on for 0.4 seconds. The complete test requires 25 seconds and happens only when the batteries are changed.

Calibration Check

Each time the thermometer is turned on, an internal check for proper calibration is made at 100.5 °F during the display test. A malfunction error will be indicated if the thermometer calibration is in error by more than 0.2 °F.

Microprocessor Self Check

Each time the thermometer is turned on, an internal check for proper microprocessor operation, including a test of the entire program, is made during the display test. A malfunction error will be indicated if any faults are located.

Cleaning and Sterilization

The Model 600 unit and probes should periodically be cleaned by wiping it with an alcohol soaked cloth or pad, warm water or non-staining disinfectant.

Do not autoclave or immerse the Model 600 unit.

Under conditions where an alcohol wipe or germicidal wipe are inadequate, the unit may be sterilized in Ethylene Oxide (ETO). This is to be done at no more than 100 °F and 85% humidity. It is to emphasized that this procedure is to be used only when absolutely necessary. It is imperative that the batteries must be removed from the unit before ETO sterilization.

Battery Replacement

Remove the battery access screw by turning it counter clockwise with a Phillips screwdriver.

Slide the battery access cover away from the battery access label to expose the batteries.

Install 3 new AA batteries paying special attention to the + and - marks in the battery compartment.

Slide the cover back into place and install the screw, turning it clockwise.

As soon as the batteries are installed, a special display test is activated which sequentially lights then extinguishes each display segment. The entire test lasts about 25 seconds. NOTE: if the horn is activated by installing new batteries allow the display test to finish, then activate the pulse timer to reset the horn.

Calibration Key Procedure

1. Remove probe plug and insert calibration key.
2. Place switch in Monitor Mode.
3. Install and remove probe from probe guide to reset thermometer.
4. Wait for the display test, then observe display.
5. Display should read 36.6 ± 0.1 °C or 97.3 ± 0.2 °F
6. Install probe in probe guide to turn unit off.
7. Remove calibration key and insert probe plug.

Test Procedure

Power Up Display Test

1. Install a new set of batteries.
2. Immediately upon inserting the last battery, the display test will start.
3. Observe all display segments as they are sequentially lighted and then extinguished. Every segment must be visible.
4. If the horn sounds when the batteries are installed, wait for the display test to be completed and then press the timer switch to reset the horn.

Startup Display Test and Calibration Check

1. Set the normal/monitor switch to the monitor position.
2. Insert a calibration plug into the thermometer.
3. Observe the startup display test and check that all segments except the timer are lighted.
4. Following the display test, the unit should indicate the temperature stated on the calibration plug.
5. Note also that the horn sounds for a brief period as a test.

Switch Tests

With the thermometer on and the calibration plug installed, activate the °F/°C, backlight, and timer switches and observe that the proper response is obtained.

Insert and remove a probe to test the probe switch action.

Placing the normal/monitor switch in the normal mode should cause the “M” to not be displayed when the unit is turned on.

Low Battery Indicator

1. Set a variable DC power supply to 5 volts and then connect it to the thermometer in place of the batteries.
2. With a calibration plug installed and a temperature being displayed, slowly reduce the power supply voltage until the low battery condition is indicated. The power supply voltage must be 3.0+.3 volts.

Power Consumption

1. Set power supply at 5 volts.
2. Remove cal plug and let timer run out so that no display is showing.
3. The average current should be less than 50 microamperes.
4. Set switch to monitor mode.
5. Install probe or calibration plug.
6. The average current should be less than 1.5 milliamperes.

M9600 Procedure

The M9600 Calibration Tester provides a convenient means of testing the entire thermometer system (instrument and probe). The 9600 must be warmed up and stable at one of the two available

temperature settings. The thermistor based instrument under test must be in Monitor mode and no probe cover loaded. The probe is inserted into the small hole in the dry heat well of the 9600 and allowed to settle for 2 minutes to the final temperature. The reading on the thermometer must be within the range specified on the 9600. Refer to the M9600 Operation Manual for complete instructions.

Note: All Diatek thermometers (thermistor and infrared ear thermometers can be tested in the M9600.)

If you are having problems with the use of the M9600, refer to the Troubleshooting section in the M9600 Operation Manual.

MODEL 600 TROUBLESHOOTING

GENERAL

SYMPTOM	PROBLEM	TREATMENT
No Display (Temp or Timer) or low Battery Indication	Batteries Low or Incorrectly Installed	Replace Batteries
No Temperature Display, Timer OK	Probe Plug Bad or Not Seated	Reconnect or Replace Probe
	Probe Switch Not Activating	Replace S1
Missing or Faded Display Segments	Broken LCD Frame, Bad LCD, LCD Connector Flex Strip, Solder Bridge or U2	Locate and Repair
Broken Probe Indication	Defective Probe	Replace Probe
	Bad Q6 FET	Replace Q6
Malfunction Indication	Unit Cannot Self Calibrate or Microprocessor has a Malfunction	Clean Main PC Board
		Replace Q3, Q4, Q5, C2, R3, R4, R5, or U2
	Certain Broken Probe Conditions	Replace Probe

MODEL 600 TROUBLESHOOTING (PCB ASSEMBLY)

No Display:

Processor clocks U2-59, 21
Display enable U2-10
Display Voltages U2-23, 24, 25

Malfunction Error or Off Cal:

With power off, measure R3, R4, and R5
Values must be within ± 5 ohms

FET Checks:

If malfunction error is showing check for any FET leakage by connecting the voltmeter across R3, R5 and probe with a cal plug in place. (The meter must not be grounded.) The voltage across the resistors must not be measurable (10 millivolts or less).
Ground the gate of Q6 and perform the same test.

Check for FET Turn On:

Malfunction error: Measure the low state voltage of each FET as it turns on following a probe switch activation check Q3, Q4, and Q5. The low state voltage should be less than 20 millivolts.
Off Cal: Check Q3, Q4, Q5 and Q6 as above.
If the above tests fail to show the failed component, replace C2, then U1.

Missing or Faded LCD Segments:

1. Loose LCD frame
2. Dirt or oil under zebra strip
3. Exposed PCB clad running between pads on LCD board
4. Solder bridges
5. Broken flex cable

Unstable monitor cal or bad predict test: (2 °F add on) or malfunction: replace C2.

Malfunction error, probe switch not working correctly:

S1 shorted to R3 trace under S1 switch—lift switch off PCB slightly.

Backlight:

Must be tested with a monitor mode temperature being displayed.

Weak Backlight:

Check transformer type or C5.

No Backlight:

1. Check for square wave on Q1 or Q2 collector, if square wave is present, check continuity of T1 secondary about 1K ohms)
2. U1-13 and Q1, Q2 emitters must go low
3. Bad or open C5 will cause the square wave to be much too high in frequency (should be about 400 Hz)
4. U1-12 must go high
5. U2-12 must go low

Horn:

1. U2-64 must go high
2. RN1-D or E

PARTS LIST (units with serial numbers equal to or greater than 193309)

REFERENCE DESIGNATOR	DESCRIPTION	DIATEK P/N
U1	IC, MOG-3242 MONOCHIP	54124-000
U2	IC, UPD75036 G-12 MASK ROM	54123-000
C1	CAP, 47µF/6.3V 20% TANT	46090-0000
C2	CAP 15µF/10-16V 10% TANT	46123-000
C3, C6, C7	CAP, 33pF MICA	46091-000
C4	CAP, .47µF/35V 20% TANT	46013-000
C5	CAP, .01µF/100V CERAMIC	46094-0000
C11	CAP, .1µF 50V	46109-0000
CR2, CR3, CR4, CR5, CR6, CR7	DIODE, IN459	44011-0000
Q1, Q2, Q7	TRANSISTOR, PN2222	50004-0000
Q3, Q4, Q5, Q6	FET, PWR VN10KM	50021-0000
Q8	TRANSISTOR, SIGNAL, 2N4124	50014-0000
R1, R2	RES, 18K, 1/4W 5%	40040-1840
R3	RES, 6810 1/8W .1% RN50	40266-811
R4	RES, 5760 1/8W .1% RN50	40265-761
R5	RES, 4990 1/8W .1% RN50	40264-9910
R6	RES, 200K 1/4W 5%	40040-4730
R7	RES, 33K 1/4W 5%	40040-3340
R8, R9, R12	RES, 100K 1/4W 5%	40014-000
R10	RES, 4.3 OHM 1/4W 5%	40040-430
R11	RES, 10K 1/4W 5%	40040-1040
R13, R15	RES, 2M 1/4W 5%	40040-206
RN1	RES SIP 100K 1/10W	40259-000
S2, S3	SWITCH, SLIDE	58100-000
S4, S5	SWITCH, CONTACT	58096-000
S4, S5	CONTACT, BOTTOM	58097-000
J2	CABLE, FLEX 30 COND	58103-000
T1	TRANSFORMER	52005-000
X1	CRYSTAL 32.768 kHz	47006-000
J1	CONNECTOR, PROBE	58105-000
S1	SWITCH, PROBE	58101-000
LS1	HORN, PIEZO	58102-000
DS1	LCD DISPLAY	60011-000
DS2	LAMP, ELECTROLUMINESCENT	58104-000
	ZEBRA FRAME	25092-000
	CONNECTOR, ZEBRA	58112-000
C8, C9, C10	CAP, .01µF/100V 10% CERAMIC	46009-000
	WINDOW DISPLAY	25103-000
	BATTERY, AA ALKALINE	53009-000
	SCREW, SELF-TAP 4 X 7/8 CSK 82° PLASTILOK	83035-000
R14	RES, 1 OHM 1/8W 5% CF	40040-011
	PCB, DISPLAY	56048-000

	PCB, MODEL 600 THERMOMETER	56078-000
	SCREW, MACH 4-40 X 1 1/16 PHD	83036-000
	SCREW, THD ROLL #4 X 3/4 CSK 82° PLASTILOK (2)	83037-000
	SCREW, THD ROLL #4 X 1/4 CSK 82° PLASTILOK (2)	83021-000

PARTS LIST (units with serial numbers less than 193309)

REFERENCE DESIGNATOR	DESCRIPTION	DIATEK P/N
U1	IC, MOG-3242 MONOCHIP	54124-000
U2	IC, UPD75036 G-12 MASK ROM	54123-000
C1	CAP, 47µF/6.3V 20% TANT	46090-0000
C2	CAP 15µF/10-16V 10% TANT	46098-000
C3, C6, C7	CAP, 33pF MICA	46091-000
C4	CAP, .47µF/35V 20% TANT	46013-000
C5	CAP, .01µF/100V CERAMIC	46094-0000
C11	CAP, .1µF 50V	46109-0000
CR2, CR3, CR4, CR5, CR6, CR7	DIODE, IN459	44011-0000
Q1, Q2, Q7	TRANSISTOR, PN2222	50004-0000
Q3, Q4, Q5, Q6	FET, PWR VN10KM	50021-0000
R1, R2	RES, 18K, 1/4W 5%	40040-1840
R3	RES, 6810 1/8W .1% RN50	40266-811
R4	RES, 5760 1/8W .1% RN50	40265-761
R5	RES, 4990 1/8W .1% RN50	40264-9910
R6	RES, 200K 1/4W 5%	40040-2050
R7, R8, R9, R10, R12, R13	RES, 100K 1/4W 5%	40014-1050
R11	RES, 4.7K 1/4W 5%	40040-4730
R13, R15	RES, 2M 1/4W 5%	40040-206
S2, S3	SWITCH, SLIDE	58100-000
S4, S5	SWITCH, CONTACT	58096-000
S4, S5	CONTACT, BOTTOM	58097-000
J2	CABLE, FLEX 30 COND	58103-000
T1	TRANSFORMER	52005-000
X1	CRYSTAL 32.768 kHz	47006-000
J1	CONNECTOR, PROBE	58105-000
S1	SWITCH, PROBE	58101-000
LS1	HORN, PIEZO	58102-000
DS1	LCD DISPLAY	60011-000
DS2	LAMP, ELECTROLUMINESCENT	58104-000
	ZEBRA FRAME	25092-000
	CONNECTOR, ZEBRA	58112-000
C8, C9, C10	CAP, .01µF/100V 10% CERAMIC	46009-000
	WINDOW DISPLAY	25103-000
	BATTERY, AA ALKALINE	53009-000
	SCREW, SELF-TAP 4 X 7/8 CSK 82° PLASTILOK	83035-000
R14	RES, 1 OHM 1/8W 5% CF	40040-011
	PCB, DISPLAY	56048-000

PCB, MODEL 600 THERMOMETER	56078-000
SCREW, MACH 4-40 X 1 1/16 PHD	83036-000
SCREW, THD ROLL #4 X 3/4 CSK 82° PLASTILOK (2)	83037-000
SCREW, THD ROLL #4 X 1/4 CSK 82° PLASTILOK (2)	83021-000

RECOMMENDED SPARE PARTS FOR MODEL 600

(100 INSTRUMENTS PER YEAR)

REFERENCE DESIGNATOR	DESCRIPTION	DIATEK P/N	QUANTITY
	NECK STRAP ADJUSTOR	25085-000	2
	FRONT CASE	25088-001	5
	BACK CASE	25089-001	10
	MID-FRAME	25090-000	2
	BATTERY DOOR	25091-001	2
	ZEBRA FRAME	25092-000	15
	WINDOW	25103-000	4
	DIODE, 1N459	44011-0000	4
C1	CAPACITOR	46090-0000	2
C2	CAP 15µF 10-16V/10% TANT	46123-000	2
X1	CRYSTAL 32.768 kHz	47006-000	4
Q1, Q2, Q7	TRANSISTOR, 2N2222	50004-0000	4
Q8	TRANSISTOR, 2N4124	50014-0000	2
Q3, Q4, Q5, Q6	FET, PWR VN10KM	50021-0000	2
T1	TRANSFORMER	52005-000	1
U2	IC, UPD75036 G-12 MASK ROM	54123-000	2
U1	IC, MOG-3242 MONOCHIP	54124-000	2
S4, S5	SWITCH, CONTACT	58096-000	4
S4	CONTACT, BOTTOM	58097-000	4
S2, S3	SWITCH, SLIDE	58100-000	4
S1	SWITCH, PROBE	58101-000	5
LS1	HORN	58102-000	4
J2	FLEXIBLE CABLE	58103-000	4
DS2	LAMP, ELECTROLUMINESCENT	58104-000	10
J1	CONNECTOR, PROBE	58105-000	6
	CONNECTOR, ZEBRA	58112-000	10
	BATTERY CONTACT, COMMON	58411-000	20
	BATTERY CONTACT, POSITIVE	58412-000	10
	BATTERY CONTACT, NEGATIVE	58413-000	10
DS1	LCD DISPLAY	60011-000	10
	LABEL SET	70158-000	20
	SERIAL NUMBER LABEL	70437-000	10
	RED WIRE, 26 AWG STRANDED	80013-0002	2FT
	BLACK WIRE, 26 AWG STRANDED	80013-001	2FT
	TY-RAP	80038-0000	4
	VINYL CORD, NECK STRAP	80080-000	2

SCREW, THD-ROLL #4X1/4 P-PL-S-Z	83021-0000	4
SCREW, PLASTITE, 4-20 X 7/8 FLAT HEAD 82 DEG PL-S-Z	83035-000	2
SCREW, MACH 4-40 X 1 1/16 P-PL-S-Z	83036-0000	2
SCREW, PLASTITE 4-20 X 3/4 - FLAT HEAD 82 DEG PL-S-Z	83037-000	4

MODEL 600 PREVENTATIVE MAINTENANCE

The following suggested preventative maintenance is recommended to maximize uninterrupted service with the Model 600 Thermometer.

Units which are in service on a regular basis should have the following preventative maintenance performed every 18 months:

1. Visually inspect the thermometer and probe for physical damage which might cause future product failure.
2. Clean unit if necessary and replace batteries according to the procedures found on page 22 of this manual.
3. Perform the Power Up Display Test, Startup Display Test and Calibration Key Procedure found on page 21 and 22 of the manual.

Units which are stored for extended period and not used should have the following preventative maintenance performed every 36 months:

1. Replace batteries according to the procedures found on page 22 of this manual.
2. Perform the Power Up Display Test, Startup Display Test, and Calibration Plug Procedure found on page 22 of this manual.

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